# Why nondispersive x-ray /neutron focusing essential for nanomaterials research

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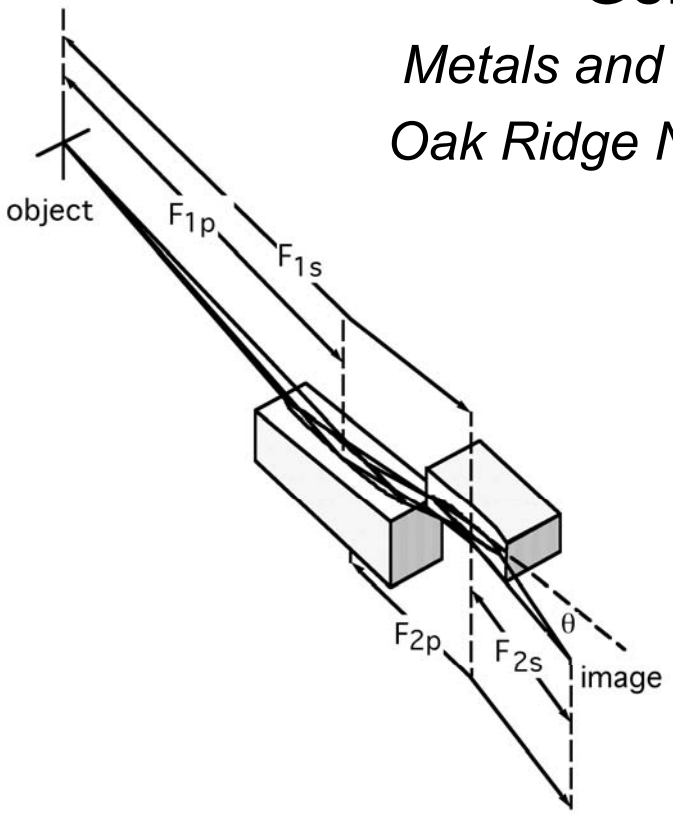
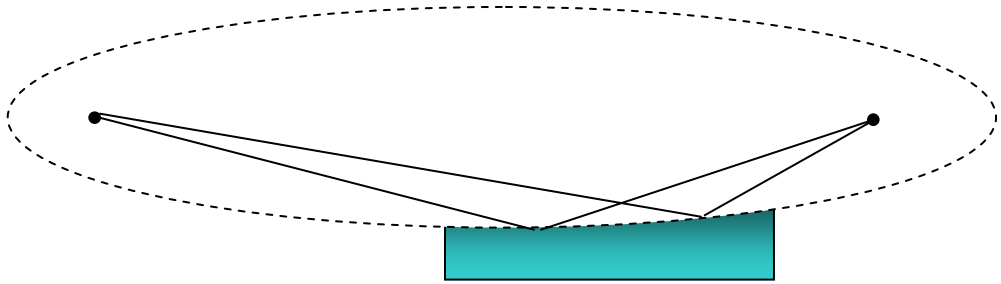


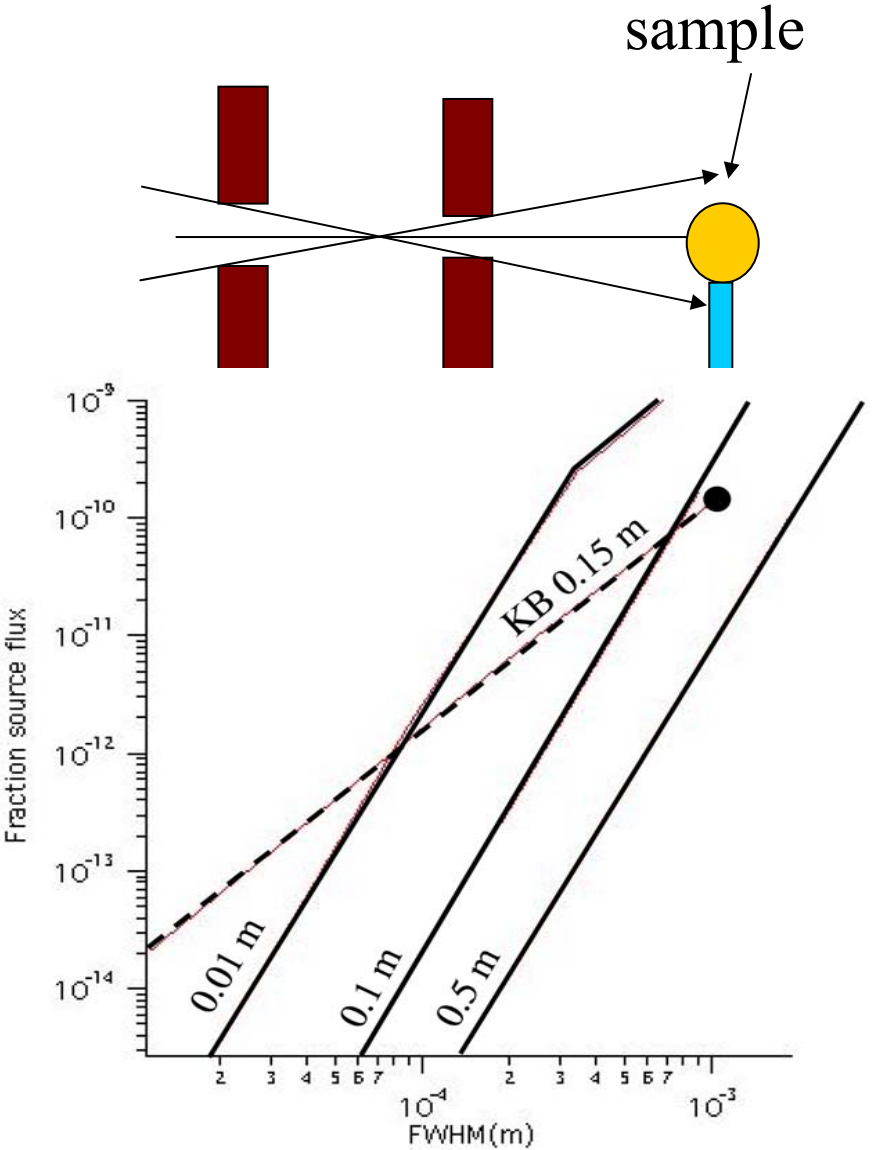



***X-ray/Neutron importance distinct/related***

# Neutron KB supermirrors provide vastly greater intensity in small beams

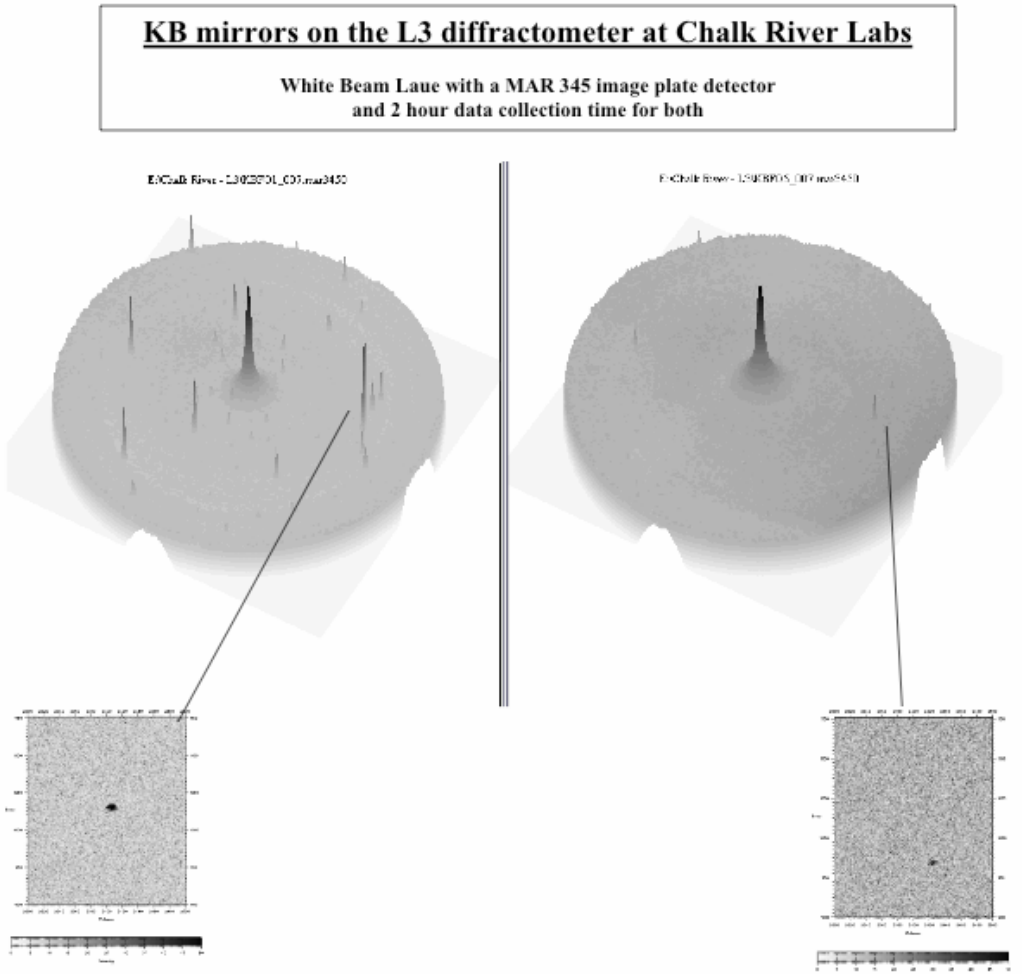
- Focus at the sample allows larger divergence
- Near source-limited brilliance within useable emittance
- Nondispersive allows for efficient use of full spectrum
- *Much* better signal and signal-to-noise for small samples

***S/ΔZ <0.007 KB preferred***



# Prototype demonstrates advantages

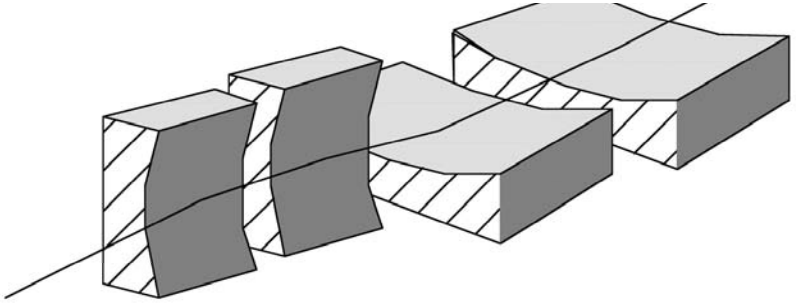
- **Signal near source limit**
- **Best signal-to-noise**
- **Well within state-of-the-art**



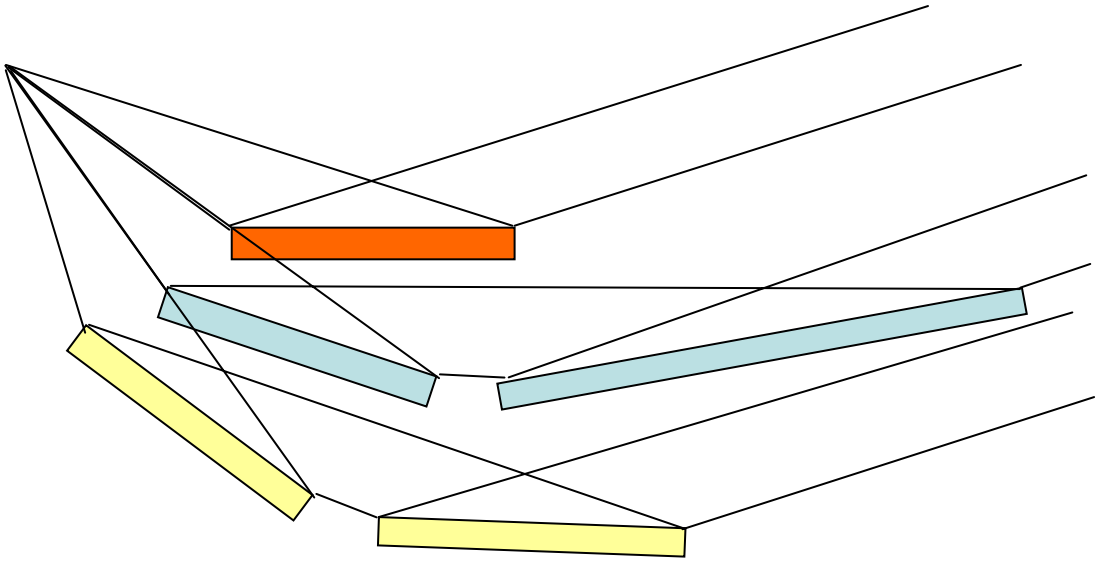
# More advanced Neutron KB systems practical

•Nested mirrors-2.5 x performance

•KBA Crossed Paired Sagittal focusing- larger divergence?

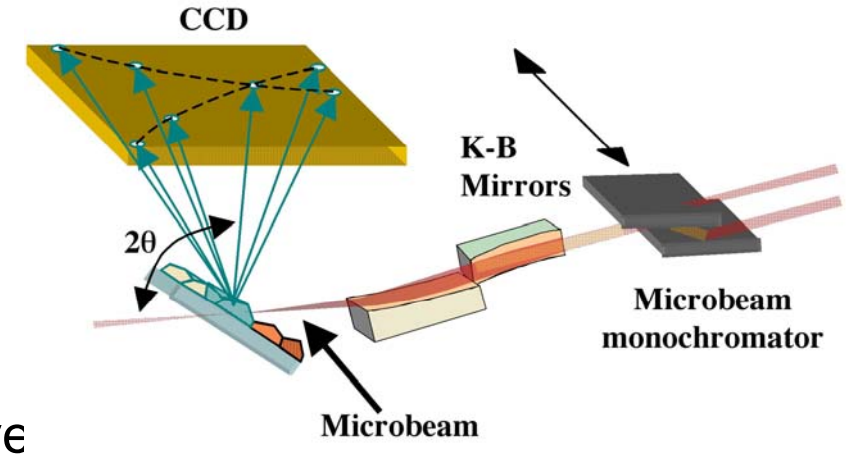


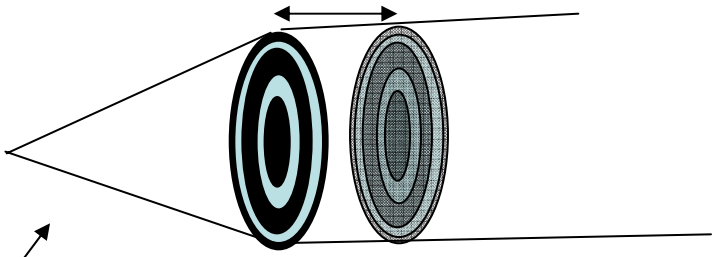
•DKB™ Deflections extend divergence collected

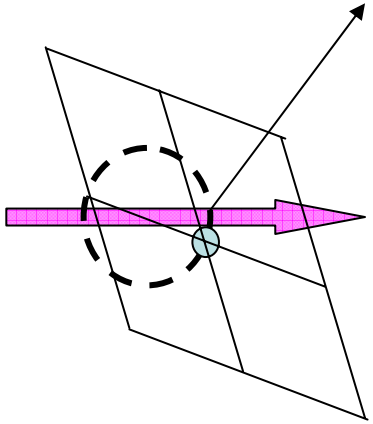


# Nondispersive KB X-ray optics essential for - individual nanoparticles

- Fewer motions
  - No sample rotations for diffraction
    - Laue diffraction
    - Mono scans-reciprocal space
  - Min motions for spectroscopy
  - At diffract limit ~500 x less dispersive
- Efficient use of beam
  - Wide bandpass fluorescence
  - Survey diffraction
- Smallest beams?

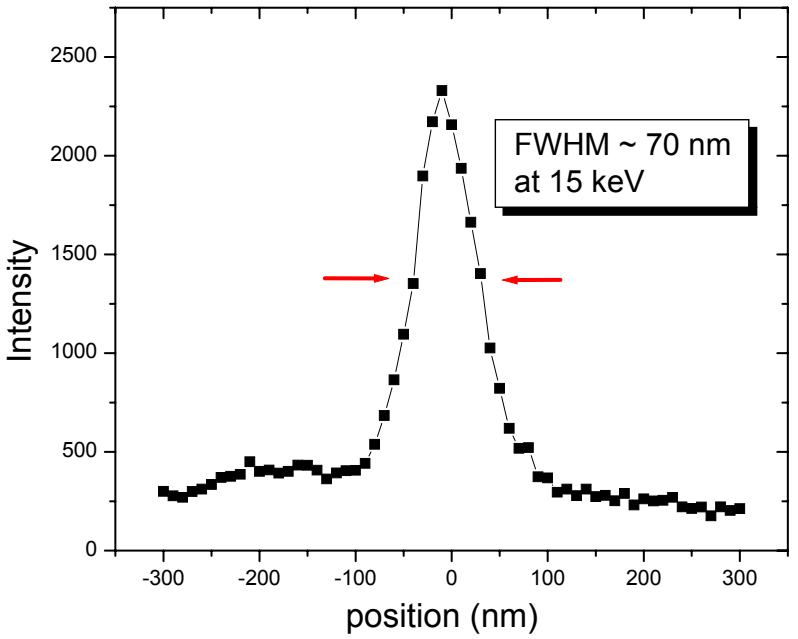


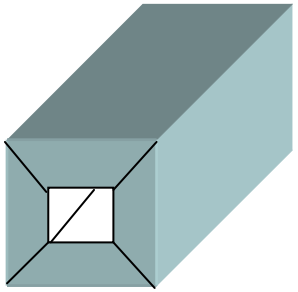





# KB mirror systems produce ultra-small beams

- Spring-8 <40 nm
- APS/ORNL collaboration KB optics
  - Beams < 68 nm *With* large vibration component!
- Simple KB system diffraction limit ~25 nm- nested improves to ~15 nm
- Other approaches can produce 3-10 nm
  - Multilayers, 4- corners etc., deflected



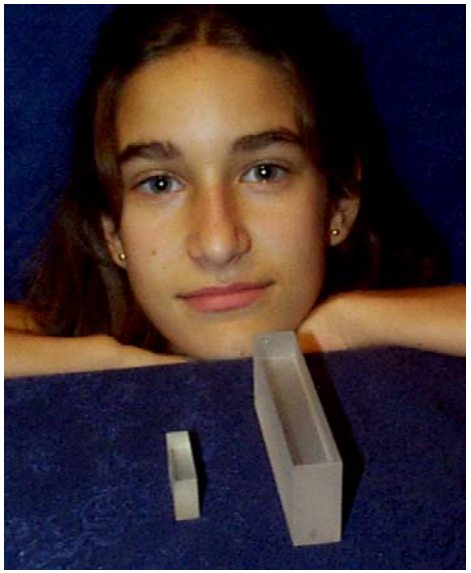



***Major obstacles: figure error control, metrology, alignment, thermal/ vibration stability***

# Conclusion: Advanced nondispersive focusing essential for nanomaterials

- Will allow neutron measurements of precious small sample volumes

- Will allow x-ray measurements on single particles, in situ, graded materials



# Other ideas

- Neutron sources optimized for brilliance/ not flux - nonlinear optics
  - Wild ideas need neutron community realism
- Wolter optics conceptually powerful- require new fabrication methods
- Differential aperture microscopy offers powerful 3D for diffraction and spectroscopy
- Phase calculations essential for nm beams
- Combined imaging/scanning microprobe need to find features